New camera improves quality of pictures taken in space

In its continuing effort to remain at the cutting edge of photographic hardware technology and in an attempt to simplify training and procedures for crews on board shuttle and station, NASA has certified the Nikon F5 for both IVA (Intravehicular Activity) and EVA (Extravehicular Activity) use.

The commercial Nikon F5 has flown IVA on STS-88 and STS-96. The F5 was successfully demonstrated for EVA use for the first time during the recent STS-103 space shuttle mission.

The Nikon F5 is expected to improve the quality of the pictures taken by astronauts during space walks. It will decrease the number of inadvertent exposures taken during EVAs and reduce the time needed to train future crews in the use of photographic equipment.

"This camera is a perfect example of NASA saving cost by using commercial-off-the-shelf hardware for space applications. The only modifications to the COTS hardware were a lubrication change and the addition of a thermal blanket," said Dena Haynes, NASA camera project manager. "The camera team did an excellent job getting this camera certified for space in a relatively short time frame."

The primary functional differences between the Nikon F3, the EVA camera now in use, and the Nikon F5 cameras are the auto focus and the matrix metering capabilities, both of which are expected to improve the quality of pictures taken during space walks.

The new auto focus capability of the F5 camera allows the astronaut to focus the camera on the subject by depressing the shutter release button halfway. This is a significant improvement over the manual focus required with the EVA F3 camera.

The matrix metering capability of the F5 measures scene brightness, scene contrast, and the focused subject's distance using the camera's 5-segment matrix metering sensor. This helps improve the quality of the pictures by providing correct exposure even in extremely complex lighting situations such as those often encountered during space walks.

Certification of the new EVA camera required replacement of the existing lubricant in the camera and lenses with a non-migrating lubricant. NASA worked closely with Nikon to modify the commercial F5's for use in space by replacing the existing lubricant with one that can withstand very cold temperatures. The thermal range that cameras encounter during space walks is between -50 degrees C and 110 degrees C. The camera team worked closely with the Thermal Analysis Group to ensure that the camera would be kept within its operational temperature range. A "one hour flaps open flight rule" on the thermal cover for the lens was established.

The camera hardware team worked with the soft-goods lab to design a thermal blanket to protect the camera from the harsh environment of space. A unique feature of the thermal blanket is that the shutter release button was designed into it. A grommet was placed over the camera shutter release button to allow the astronauts to take the picture. The camera thermal blanket is made of the same material as the spacesuits, thus providing the same protection.

The thermal blanket also has a lens cover which helps keep the Nikon F5 within operational temperatures. In addition to protecting the camera from the extreme temperatures experienced in space, the lens cover reduces the number of inadvertent bad exposures since the Nikon F5 will not take a picture unless it is focused on an object.

With the exception of an action viewfinder (which gives space walkers a larger viewing area), the Nikon F5 camera will be used for both EVA and IVA. In addition to the Nikon F5 camera, the lenses certified for EVA use are the 28mm, 35mm, and 50mm Nikon lenses. Having one camera for both IVA and EVA will reduce the time needed to train crews in the use of photographic equipment. Starting with STS-101 and subsequent flights, the Nikon F5 will be the only 35mm camera on board.

EVA crewmembers including Michael Foale (STS-103), Jeffrey Williams (STS-101), Joe Tanner (STS-97) and Carlos Noriega (STS-97) were instrumental in the evaluation of the thermal blanket's ergonomic design. Their recommendations were incorporated into the final design. These astronauts were able to evaluate the thermal blanket in the EVA glove-box and in the Neutral Buoyancy Laboratory. The response from the crewmembers has been positive.

STS-103 Payload Commander Steve Smith used the new camera during the recent Hubble servicing mission.

"The F5 EVA camera is a dramatic improvement over the F3," said Smith. "On STS-82 using the F3, I was not sure if the subject, Mark Lee, was ever well framed in the picture. Getting good composition involved a lot of luck. In comparison, the F5 has a large viewfinder, which I found easy to look through. Because exposure on the F3 was fixed during large swings in lighting during the EVA, a large percentage of the pictures were not properly exposed. The F5 has a very sophisticated exposure control system that adjusts for each picture. We also have found on many EVAs that the F3 took many unintentional pictures when it was bumped; the F5, conversely, will not do this when the MLI lens cap is in place.

"Taking pictures with a handheld camera during an EVA, especially if you are the person not on the shuttle arm, is a challenging, time-consuming task. The F5 makes the task much easier and the results are a quantum leap better." ■

NASA Photo STS103-701-053

Astronaut Steve Smith, payload commander, takes a picture with an F5 camera during the final EVA of the STS-103 mission.

Human-rated thermal vacuum chamber made roomier

Astronauts and test directors have 132 percent more room for equipment and maneuverability in the thermal vacuum chamber since the installation of a new traversing rail last summer.

The human-rated thermal vacuum chamber, built in the '60s and a National Historic Landmark since 1985, has been the site for hundreds of tests for space flight hardware and crew operations at JSC. Its capability to incorporate humans in the thermal vacuum environment is unique in the world, making it a workhorse for the space program. But the growing scope of the space program from the International Space Station assembly schedule has caused increased demands for testing. Faced with a growing docket of new and bigger hardware to be tested, it became evident a solution was needed.

After some assessment, it was determined that more than half of the chamber was inaccessible by crewmembers in its original configuration. The crewmembers relied on an overhead rail to absorb the 300-lb weight of the spacesuit in the chamber so they were limited to going only where the rail was installed – a straight line from the chamber entrance directly across the chamber with a six-foot traverse to its left. Additionally, to get the crewmembers inside the chamber from their suit-up area outside, a dated winch motor mechanism was used by the crewmembers to coast up the shallow incline into the chamber.

"It required a lot of energy from the crewmembers just to get into the chamber and the test hadn't even started yet," said Mary Cerimele, NASA test director. "Plus, using that mechanism put us only one cable away from a serious problem."

It was determined that adding another section of rail with a new ingress/egress system would solve many of the chamber maneuverability issues, increase the useable chamber area, while also improving the safety of the ingress.

Instead of having a rail that limited the crewmember's mobility to only the left-most side of the chamber (essentially a 6×12 foot corridor of the 490-square-foot chamber floor), the new design would allow crewmembers to traverse another eight feet to the right as well, and essentially reach more of the testing area.

"The new monorail increased our floor space by 132 percent," said Cerimele. "If we hadn't done this, we'd have to schedule more tests to accommodate all the testing needs. That costs money and has obvious schedule implications. There simply was too much to physically fit in where a crewmember could reach it, so we had to limit the number and size of items that could be tested each time."

Prior to the addition, the chamber could accommodate about seven items per test. However, during their last test, which was the first one with the new rail system, they were able to complete testing on 11 components, three of which would not have fit in the old chamber layout.

The new system incorporates a chain drive to hoist the suited crewmembers up and down the gentle incline to the testing chamber. The mechanism is predicated on the same pin-and-chain system a roller coaster uses to hoist its load. The crewmember can complete the strenuous ingress and egress much more quickly and with no actions required by the crewmember because the attachment to the chain is now automated. The chain drive also now blocks an inadvertent coast down the incline during test, a hazard the test team previously had to rigorously control. A second framework, six feet above the first, also was installed for a pulley system to suspend the heavy crewmember tools during the test.

"It's safer and conserves the crewmember's energy," said Sam Garcia, one of the facility mechanical engineers. Garcia was an integral part of the redesign team to engineer the new rail and support system. He also was the first human subject for the system's acceptance testing.

"The engineers and technicians who put this together were exceptional," said Cerimele of the team, some of whom worked 80-90 hours a week designing and building the new stainless steel framework. "They had this built and certified in a couple of months. That is a very short time for such a major redesign."

Designing hardware for the hostile environment of the chamber, which has a temperature range of minus 200 °F to plus 250 °F or higher, presented unique challenges. Special motors had to be installed that could operate remotely to test the system before the human tests. And each of the motor actuators has to be warmed to ensure they can operate in the frigid temperatures.

"The new rail represents a long-awaited capability for our facility," added Cerimele, "and is in keeping with a faster, better, cheaper way of doing business."

The team is preparing for its next chamber test, which is set for later this spring. In the meantime, the chamber will be getting its next enhancement – a new video monitoring system, which should be installed this month replacing the old black-and-white system. ■